Electric charges & fields

Electric force

$F = \frac{K q_1 q_2}{r^2}$

$K = \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$, $\varepsilon_0 = 8.85 \times 10^{-12}$

Velocities of charges performing UCM.

$V = \sqrt{\frac{K q_1^2}{2mr}}$

Sharing of charge by touching

- Before touching
- during contact
- After contact

$q_{net} = q_1 + q_2$

$q_1' = q_2' = \frac{q_1 + q_2}{2}$

Electric dipole (P)

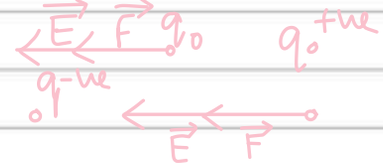
$P = 2a \times q$

Electric flux (ϕ)

$\phi = E A \cos\theta$, $\phi_{net} = q_{enclx} \frac{1}{\varepsilon_0}$

Electric field intensity

$E = \frac{F}{q_0}$, for +ve charge, for -ve charge



$E_p = \frac{KP}{r^3}\sqrt{3\cos^2\theta + 1}$

- On axis ($\theta = 0°$)

$E_{axis} = \frac{2KP}{r^3}$

- On equator ($\theta = 90°$)

$E_{eq} = \frac{KP}{r^3}$

Torque acting on an electric dipole (in uniform electric field)

$\vec{\tau} = \vec{P} \times \vec{E}$

$\tau = PE \sin\theta$

$W = U = PE(\cos\theta_1 - \cos\theta_2)$

Charge distribution

1. linear (λ) $\lambda = \frac{q}{l}$
2. Surface (σ) $\sigma = \frac{q}{A}$
3. Volume (ρ) $\rho = \frac{q}{V}$

Electric field intensity due to . . .

1. a point charge, $E = \frac{Kq}{\ell^2}$
2. a line of charges, $E = \frac{2K\lambda}{\ell}$
3. A plane infinitely long sheet of charges, $E = \frac{\sigma}{2\varepsilon_0}$
4. Hollow conductor sphere, $E = \frac{\sigma R^2}{\varepsilon_0 \ell^3}$